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ABSTRACT

This paper describes the implementation of educational computing in three schools located in the suburban belt of a large metropolis. One school included grades K-6; one grades 5-6; and one grades 7-8. The schools were similar in that they were well financed and the staff and students felt they were doing well; however, they were different in the ethnic composition and socioeconomic level of their student bodies. All three schools provided inservice training for their teachers and purchased hardware and software. It was found that the distinctive features of each school conditioned the extent of computer use and shaped the form and substance of the educational computing program at the initial stages of implementation. The strongest determinants of the kind of computer activities implemented and the relationship between computer activities and other school work were found to be the staff's perceptions of the student body and what constitutes legitimate school knowledge, together with the style of student supervision. (30 references) (Author/EW)

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THE IMPACT OF SCHOOLWIDE AND CLASSROOM ELEMENTS ON INSTRUCTIONAL COMPUTING: A CASE STUDY

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ABSTRACT

The paper describes the implementation of educational computing in three schools. In all of them the administration aimed its support at in-service training and the purchase of hardware and software. Computer literacy by itself does not produce generalized computer use. Command over technical and social resources is a necessary but not a sufficient condition for the systematic implementation of instructional computer activities. Staff's perceptions of the student body and of what constitutes legitimate school knowledge and the style of student supervision are the strongest determinants of the kind of computer activities that are implemented in the classroom and of the relationship between computer activities and other schoolwork.

During the last five years schools have purchased computers in great numbers, but, in order for instructional computing to have an impact on student learning teachers must use micros systematically. This has not been the case in many of these schools. This paper contributes to an analysis of why teachers have been reluctant to use computers as an instructional tool by analyzing the ways in which distinctive features of three schools--one K-6 grade school, one 5-6 grade school and one 7-8 grade school--conditioned the extent of computer use and shaped the form and substance of educational computing in the initial stages of its implementation. The paper draws attention to the structural arrangements in which teachers worked and the ways in which these structures were interpreted and acted upon by teachers, thus creating and recreating the conditions under which educational computing took place.

Theoretical Context

In using the term "structure" I refer both to the organizational framework of schools, the differentiation of positions, the rules, the procedures and the prescriptions of authority, as well as to the emergent patterns of interaction, to the ways in which "actors actually transact their work,

formulate policy, and allocate resources." (Ranson, Hinings and Greenwood, 1980).

Such a concept brings together the organizational framework with actors ways of making sense of the world and the patterned regularities that they create and recreate (Bartunek, 1984; Ranson, Hinings and Greenwood, 1980). Thus, this understanding of structure leads to an examination of the interpretive schemes of actors, those cognitive schema that map their experience of the world and to an identification and interpretation of its relevant aspects (Ranson, Hinings and Greenwood, 1980). In addition, acknowledging that not all social actors have the same power to shape and constitute structure according to their understandings of reality makes it necessary to examine those relations of power that enable some organizational actors to do so (Ranson, Hinings and Greenwood, 1980). Typically, research about schools has not studied these dimensions of structure in an integrated fashion.

Recent studies of educational computing have described how aspects of the structural, symbolic and political dimensions of schools have affected the implementation of instructional computing.

Lack of technical and social resources has been singled out as a major structural constraint to developing teacher commitment to educational computing. First, scarce hardware or

hardware with inadequate peripherals, limited or inadequate software and a shortage of skilled staff are recurrently mentioned as major constraining factors. This is to be expected when the majority of schools that have microcomputers have fewer than ten (Becker, 1985). Consequently, decisions about computer allocation are crucial, they can enhance or limit access to the hardware, expand or reduce time spent doing computer activities (Becker, 1985) as well as affect the degree to which instructional computing remains peripheral to school work (Sheingold, Hawkins and Cher, 1984).

Second, the kinds and amount of software available in the schools delineate the range of activities that can be implemented (Sheingold, 1982). Teachers complain that their choices are limited (Ancorrow, 1986). In effect, most of the software available in elementary schools is for drill and practice, particularly in math and the language arts (Becker, 1985).

Third, the relatively small number of teachers who are competent computer users is another limitation to the expansion of educational computing. Few teachers can design and implement computer activities suitable to their curricular needs (Jungck, 1985).

Aside from the availability and allocation of resources, two others structural elements shape the implementation of

educational computing. At the school level, different patterns of interaction between teachers create different channels of access to those with computer knowledge. Regular interaction between teachers fosters the creation of support groups for learning and experimenting with computers while little contact between them limits the ability of isolated innovators to influence their peers (Sheingold, 1982; Wright, 1987).

At the classroom level, established styles of teacher-student interaction set limits to what can be done with computers. Instructional computer activities adapt to the style of existing classroom practice instead of radically changing it (Chandra, 1984; Wright, 1987).

In and by themselves, these structural elements do not determine how educational computing is implemented. Teachers' perception of their students' needs, of how organizational arrangements constrain or enhance their work (Chandra, 1984; Jungck, 1985), their confidence about their computer expertise (Chandra, 1984), and their assessment of the pay-offs they will get by carrying out instructional computing in their classrooms affect their commitment to the new technology.

Teachers are the ones who have to figure out how to integrate computers into the curriculum (Sheingold, Hawkins, Cher, 1984). Their undertanding of what type of instruction would benefit their students influences the kind of software

they select and the extent to which they use computers (Becker, 1985). Whether an elementary school provides drill and practice software and microcomputers to lower achieving or to better prepared students reflects different assumptions about the role of personal interaction in helping students to master basic skills (Becker, 1985). Teachers' notions about the extent to which computers should be used and what they should be used for are influenced not only by their understanding of the curriculum they have to teach but also by their views about classroom management. Chandra (1984) found that those teachers who think that they should be an authority figure in the classroom often disapprove of the use of computers. Finally, understandings about educational computing are affected by teachers' conception about computers. Many teachers describe themselves as "not logical" and thus unable to learn how to use microcomputers (Chandra, 1984).

Research on school organization can draw light on the process of implementation of educational computing. Studies about the salient aspects of the structural arrangements of schools have shown that their organizational framework (Lortie, 1975), available resources (Gross, Giacquinta and Bernstein, 1975) and the patterns of work in the classroom (Doyle, 1981) shape teachers' planning and work.

Dan Lortie (1975) has shown how the cellular form of

school organization and the way space and time are patterned, works against teacher interaction, and, as a result, fosters individual solutions to shared problems.

Gross, Giacquinta and Bernstein (1975) found that lack of two basic resources (skilled staff and adequate tools and materials) acounted to a large extent for a failed innovation. In their research on classroom context, Cohen, Intili and Robbins (1979) have found that different kinds of activity structure demand different kinds of student supervision. When the teacher organizes the class so that several tasks take place simultaneously the opportunity to give individualized assistance increases and control of student behavior is less visible than during whole class instruction (Bossert, 1979). Small group and individualized instruction increase the complexity of the activity structure and demand the replacement of direct control by bureaucratic forms of control (Cohen, Intili and Robbins, 1979). Direct control is based on direct surveillance of students' work. Bureaucratic control is based on the development of rules that prescribe what to do in standardized activities created for students. Delegated control is based on granting students the right to make decisions regarding their learning within certain parameters that insure that they have internalized the premises that teachers value.

Although research on classroom management has shown the connection betwen activity structure and management style, it has not taken notice of how teachers' understandings about their work affect their selection of activities. This has been done in studies of how teachers make sense of their reality. Of special interest to this discussion are studies of faculty culture. This occupational culture deals with the problems teachers face as they carry out their work. Moreover, faculty subcultures may emerge when groups of teachers in a school face specific problems. (Metz, 1984). Themes of the faculty culture are translated into classroom practice, but at the classroom level, circumstances which are specific to the setting create variations in those themes. The principles and beliefs expressed in the faculty culture are translated into teachers' perspectives which are constituted by rules for work that they negotiate daily with colleagues, administrators and students (Page, 1984).

Assumptions about their students, about their work and about subject matter underlie teachers' selection of instructional activities. Different perspectives lead to different definitions of the reality of work and the classrooms which lead, in turn, to different practices (Popkewitz, 1978). Distinctions such as "traditional" and "progressive" or "subject-centered" and "child-centered" are useful to map

teacher assumptions, but teacher practices reflect a complexity that is not captured by these ideal types (Woods, 1983). At times teachers may bring to bear aspects of different perspectives on the same situation (Berlak and Berlak, 1981). Moreover, circumstances that are specific to a teaching setting can constrain or enable the implementation of the idealized perspective (Woods, 1983).

As I indicated above, recent research on classroom context has shown that academic tasks affect classroom management (Doyle, 1981) and that different kinds of activity structure demand different kinds of student supervision, but it has ignored the role played by teachers' perspectives in choosing activity structures. Teachers select certain activity structures because they think that they are the best suited for their aims given the practicalities of the classroom situation. Moreover, teachers may choose activity structures in order to create the conditions for a preferred kind of supervision.

The power relations which prevail in a school, enhance the ability of some school members to make their interpretations of reality heard. The control exercised over teachers' work is a salient aspect of these power relations. This control can be personal, bureaucratic or, as Andrew Gitlin (1980) found, it can be embedded in a curriculum that specifies behavioral objectives and classroom activities, sets a pace of work and

evaluates students according to the number of objectives the students have accomplished. At the informal level, interpersonal politics is another aspect of power relations in the school. Interpersonal politics involves the strategic use of power that allows teachers to protect their own behavior and to influence that of others (Blase, 1987).

The analysis of how educational computing was implemented in three schools which follows expands or illustrates several of the themes from the research described above. In attempting to account for the emergence of several commonalities as well as considerable differences in the way educational computing was implemented in these three schools this analysis argues that the definition of educational computing at each of the schools was socially constructed by the faculty. In addition, it examines the dynamic by which themes about instructional computing were constructed. It does so by examining the specific conditions for the development of educational computing set by the structural framework of each of the schools and by examining how these were interpreted differently according to the teachers' own strategic interests. Finally, it argues that the way in which educational computing was implemented at each of the schools was strongly influenced by the power relations that structured interaction between the teachers. The ability of the "computer buffs" to impose their

views about educational computing and the ability of various teachers to resist them was a function of the type of control over teachers' work and the interpersonal politics that prevailed at each of the schools.

The Schools and their Communities

The three schools in this study are located in the suburban belt of a large metropolis. Oakgrove [1] is located in one suburb, Elmway and Cedar Ridge in another. The communities share some similarities but they differ in important respects. They are similar in that they both have well financed schools, and, in both, staff and students feel they are performing well. They are different in the ethnic composition and socioeconomic level of their student bodies. Oakgrove is situated in a predominantly black neighborhood of an ethnically diverse district, with an average income substantially lower than the district's median. Elmway and Cedar Ridge are located in a district which is more homogeneous than Oakgrove's in both respects. Their student bodies are constituted by predominantly white middle class students.

Oakgrove, is an elementary school with an unbalanced racial composition--almost 80% of its students are black--located in a relatively low income neighborhood. It

was transformed into a math and computer magnet in an attempt to attract more white students. [2] Although unable to attract large number of whites, the school, which has won several awards in recognition of its excellence, has strong support among the parents of its students.

Elmway, is a cluster school for grades five and six. It started as part of a 5-8 innovative middle school housed in two buildings. The building where Elmway operates was originally a large open space with few walls. In the other building large spaces were available for teaching, but, partitions could recreate smaller areas as needed. The predominantly white middle class parents in the community disliked the open spaces, the most visible feature of the innovative education children were receiving. Many asked that their sons and daughters be placed in the building which had a more conventional architecture. As a result of this pressure, the original school was divided into two: Elmway, a 5-6 grade school and Cedar Ridge, a 7-8 grade middle school.

The distinguishing character of Elmway was compromised in part. The principal developed structural arrangements that supported two diverse styles of teaching in the same building and gave parents a participatory role in deciding to which classroom their children would be assigned. Partitions were built and a few teachers with a more traditional approach to

teaching were hired. Half of Elmway's classrooms kept close to the original spirit of the school by not separating students by age or grade and by having an open classroom emphasis. The rest became one grade classrooms with more traditional instruction.

Cedar Ridge, housed in the second building, lost much of its progessive approach when several of its child-centered teachers moved to Elmway. Interdisciplinary faculty teams were broken up, and teachers became isolated specialists teaching their subject matter.

The structure of the three schools is different. To begin with, their characteristic division of labor set them apart. At Oakgrove, teachers were responsible for a class in a self-enclosed classrooms, at Elmway that responsibility was shared with a team. At Cedar Ridge, as is typical of middle schools, teachers in self-enclosed classrooms saw their students for only one period during the day.

The typical pattern of interaction between teachers was shaped, in part, by the schools' structure, and also by informal processes that created different degrees of solidarity and support. At Oakgrove, self-enclosed classrooms isolated teachers, but monthly staff meetings and the personal, close style of supervision of the principal created a sense of participation in a common enterprise. Teachers' accepted her

tight control because they considered it was necessary to bring out the dedication their students required. At Elmway, teamwork facilitated interaction between team members, but hindered contact with members of other teams. The principal's style of coordination at Elmway was very different from that at Oakgrove, the latter was based on the assumption that teachers had professional expertise, therefore, close, direct supervision was unnecessary.

At Cedar Ridge, there was little contact between teachers, even among those working in the same department. Departmental meetings were rare, staff meetings almost non-existent. The style of coordination at Cedar Ridge was still more laissez-faire than the one at Elmway. Teachers defined it as providing them the needed freedom to pursue their initiatives and projects.

Not only did the school differ in their structures, they differed in their faculty cultures in a number of ways as well. First, each faculty had distinct images of its role.

At Oakgrove teachers thought that students, given the low socioeconomic status of their families, lacked many of the skills required to succeed in school, at Elmway and Cedar Ridge teachers assumed that the parents--many of whom were professionals, managers and small entrepreneurs-- had taught

their children the skills needed to succeed in school. Different prescriptions for effective teaching ensued. While at Oakgrove much attention was given to a caring relationship with students and developing their trust and commitment, at Elmway such attention was given to students' individual differences, and at Cedar Ridge to exposing all students to challenging subject matter.

Second, while the faculty at the three schools described themselves as professionals, they valued different dimensions of professionalism. At Oakgrove they valued commitment, at Elmway they valued their discretion to define a teaching style, and at Cedar Ridge they valued their expertise in the discipline they taught.

The Educational Computing Programs

The K-6 course of study written for Oakgrove and the K-12 course of study written for Elmway, Cedar Ridge (and other schools in that district) shared common goals. Both were aimed at teching students about the uses, functions and impact of computers in contemporary living by teaching programming and by the use of prepared programs to enhance students' learning in various areas. At the level of objectives a few differences can be singled out. First, all the objectives specified for

Elmway and Cedar Ridge are cognitive, but Oakgrove, in addition to cognitive objectives, has an attitudinal one: "to value the advantages of computerization" and to "value the uses of computers in making life more creative and interesting". Second, objectives are specified in greater detail in Elmway's and Cedar Ridge's course of study than in Oakgrove's. For instance, in the former we find that for problem solving the student will acquire programming skills, learn how to use system operating software and application software. The course of study for Oakgrove does not clarify the terms it uses in the same way. As a result, terms assume the authority and convincing power of technical language (Huebner, 1975). We are told, for instance, that the "student will develop problem solving skills and logical thinking skills through the challenges of programming and computer assisted instruction". But problem solving skills are not defined. The examples of problem solving software listed under specific objectives and of the programming languages with which students will demonstrate their logical thinking skills are not enough to clarify what is meant. An information processing model of problem solving is probably assumed, but that is not clearly stated. As a result, one could infer that through these activities students will master all kinds of problem solving approaches.

Except as broad guidelines the courses of study were not of much use to teachers. In the first place, the courses of study were written after computers were brought to these schools. The time that lapsed between the time computers were installed in the classrooms and the courses of study were written ranged from one year at Oakgrove to three years at Cedar Ridge. Second, as I already suggested, the language of the courses of study was open to interpretation regarding the nature of the skills to be attained and of the software which could be used for those purposes.

The staff in each of the three schools posed themselves four questions that pivoted around their beliefs about curriculum and about their students and around the prevaling structural arrangements in the schools. These were the questions. First, What are educational uses of computers? That is to say, Should they teach progamming? What kinds of applications should they use? Second, Where should instructional computing take place? In other words, Should computers be set up in a central location? or, Should they be distributed among the classrooms?). Third, Who should have access to computers? In particular, should all students have equal access to them? Fourth, When should students use computers? More specifically, Should students use them during regular classroom hours or during free time?

Oakgrove had forty-four computers at the time of the study. Sixteen were housed in the lab and the rest in classrooms and resource rooms. But, as is the case with many elementary schools, the capacity of a large number of the classroom computers was limited because they did not have disk drives. Computer using teachers competed for eight computers with disk drives.

The Summer before the computers were brought to the school, teachers were trained to use them. As was customary at the time, they learned how computers work and they learned some elementary programming. Several teachers took courses on their own about specific applications and a few about how to integrate educational computing into the curriculum.

Three different kinds of settings were used for computer activities at Oakgrove. One was the computer lab, where a computer teacher taught programming in BASIC and less frequently she supervised drill and practice programs. All students attended the lab for one period each week. In addition, students in grades four to six went to the computer lab with their own teachers for math drill once a week. A second place where computers were used was in the special classrooms--a resource room to teach all students observational skills and a math classroom for gifted students. In each of these classrooms, which had one to two computers with disk

drives, students used LOGO, a data base management program and problem solving software to teach students about classification (Gertrude's Secrets, Gertrude's Puzzles) and patterns (The Pond). A third place where computers were used was in the classrooms. In most of them there was one computer, in a few two. Most teachers provided drill and practice programs for their students after they had finished their work. They made no effort to give all students access to the computer nor to supervise work in the computer corner. When they selected software, most of these teachers chose one that was tightly connected to something they had recently taught. Less than a third of the teachers used computers regularly for projects which were integrated with learning activities in math, science or language arts.

Elmway had thirteen computers. The staff experienced no problem in terms of their capacity; all the micros had disk drives, and there was plenty of software for them. Each team had two computers, the rest were in the media center. Computer use varied from team to team. In one team all students took turns at the computer round the clock, usually for drill and practice and occasionally for what teachers labeled "problem solving". In two other teams computers were used predominantly before school by motivated students who volunteered to come. In a last team, computers were used mostly for games during

free time.

Cedar Ridge had twenty-four computers, sixteen of which were housed in the computer lab. There, they were used for computer literacy and more advanced computer courses every period of the day. This allocation of time made it impossible for teachers to take their students to the lab for computer assisted instruction. Before school, the lab was open for students who wished to complete their homework and for students who came to play games. The only games allowed in the lab were those students had copied from computer magazines. The computer teacher thought that students learned programming techniques by reading programs. The math classrooms had two computers each. The software used for the math classes, mostly drill and practice and a few tutorials, had been designed by the math teachers. Students who felt they needed drilling in a particular topic went to the computer corner to work on it. While in one classroom students had access to any of the programs in the computer file, in another, the teacher selected what program could be used during each period. One computer was used in the classroom of students with learning disabilities for word processing and drill and practice, another computer was used by gifted students during their study hall.

Teachers at Elmway and Cedar Ridge had been trained

in the use of computers along similar lines than those at Oakgrove. They learned how computers worked and a little bit of programming. A significant difference between Oakgrove and Elmway on the one hand, and Cedar Ridge on the other, was that while commercial software was used regularly in the former it was not used at Cedar Ridge. The thrust for educational computing at Cedar Ridge, initiated by a group of teachers who were avid programmers, was that teachers should write their own software. To that effect, an introductory computer course and a course in an authoring system was offered to the staff.

Patterns Common to the Three Schools

A first characteristic common to the three schools is that in the administration's views inadequate resources were the main obstacle to the expansion of educational computing. Consequently, their policy was to improve and expand the available hardware and to carry out teacher training.

A second characteristic common to the three schools is that, to a large extent, computer practices reproduced and legitimated the schools' structural arrangements. At the school level, there was little evidence that the school structure adapted to educational computing. Although space and time were found for computer education at two of the

schools-- in the way of computer labs--the same did not happen in the classrooms.

While teachers were expected to meet certain well defined goals in areas, such as math or science, the goal for educational computing seemed to be reduced to exposure to computers, or time spent at the computer.

Although the principals told teachers that they wanted to see an expansion of computer use, they did not encourage it either by their assignment of responsibilities or by their reward system. A case in point is that teachers were not given release time to learn new ways of using the computers or experiment with new applications.

At the classroom level, teachers did not modify ingrained practices regarding the organization of time and space, nor their ways of setting up instruction in order to carry out computer activities in a systematic manner. Instructional computing had to adapt to existing practice. If existing practice conflicted with instructional computing the latter was dropped after a trial period. Usually, computer activities flourished in classrooms where small group or individualized styles of teaching prevailed.

A third characteristic common to the three schools is the staff's predilection for structural arrangements that would segregate computers to a separate setting, a pre-determined

time for computer activities, as well as a special teacher to oversee them. At both Oakgrove and Cedar Ridge, the bulk of systematic computer activities took place in the computer lab, and although Elmway did not have a lab, the staff was looking forward to having one. Several elements contributed to this preference for a lab. First, with only one or at best two computers in each classroom for a large group of students created classroom management problems for many teachers. Second, several teachers felt they did not have the expertise to select software and implement projects that were suitable to their instructional goals.

A fourth common characteristic of the implementation of educational computing in these three schools is scant teacher supervision of computer activities and an almost complete absence of feedback about what was going on in the computer corner. Neither the majority of teachers nor any of the principals developed formal ways of finding out the outcomes of student work at the computers. The absence of teacher-student interaction about the work that was being carried out at the computer contributed to crystallize an abstract characterization of computer activities as "time spent at the computer" which was used by many teachers.

Different Patterns in the Three Schools

Structural arrangements and educational computing. The ways in which teachers work was structured at these three schools created a set of conditions to which educational computing had to adapt. At both Okagrove and Cedar Ridge teachers worked in self enclosed classrooms and engaged in few collaborative projects with their colleagues. When one teacher in the resource room implemented a data base project that required that students do library research during regular classroom time, she found that, given Oakgrove's structure and the fact that there was no precedent for collaboration across classrooms, it was difficult to gain teacher support. Oakgrove and Elmway teachers worked with the same students all day, therefore, they could schedule computer activities more easily than those working with students for just one period at Cedar Ridge. At Oakgrove and Elmway students could take turns to enter information into a data base or to use a word processor during any period--English, Math or Science.

The activity structure favored by a teacher in the classroom was a strong determinant of whether computer activites took place at all, and if they did, of whether they took place simultaneously with other school work or were relegated to those times when students had finished their work. At Cedar Ridge the allocation of computers to just a few

classrooms was the strongest obstacle to carrying out instructional computing in the others. Because of this, when discussing the relationship between activity structure and computer use, I will only refer to those teachers at Cedar Ridge who had access to computers.

The activity structures and style of student supervision that prevailed in a classroom strongly influenced the extent of computer use. A majority of the teachers at Oakgrove and Elmway favored whole group instruction and had a direct, personal style of supervision of student work. These teachers did not use computers regularly. The fact is that, because they disfavored learning activities over which they had little control, such as individualized learning activities, their efforts to use computers were shortlived. Those among them who continued to give their students access to computers, did so either during free time--after students had finished their assigned work, during recesses or during lunch periods. Most of these teachers expressed a desire to move all educational computing to a computer lab. As a matter of fact, at Oakgrove, a few teachers who rarely turned on the computer in their clasroom did take their students once a week to the computer lab for math drill. They preferred the lab for educational computing because all the students were doing the same task simultaneously, therefore, they could respond to requests for

assistance and could inspect the work of each student.

Many of the teachers who favored small group instruction or individualized work scheduled computer activities regularly. This kind of activity structure was accompanied either by a bureaucratic style of control, that is to say, one in which rules and procedures established beforehand regulated standardized student activities or by a delegated style of control, in which students were given limited discretion to choose between learning activities.

Most of the teachers with a bureaucratic style of control, a minority both at Oakgrove and at Elmway, regularly scheduled computer activities for their students. A bureaucratic style of student control standardized student work, including access, time and type of work to be done at the computer. Consequently, these teachers could manage a computer corner without disrupting classroom routines. Interestingly, although these teachers had established mechanisms to assist students and monitor their work, few among them did the same thing for those students engaged in computer activities. They only inspected the output of students' work when the software allowed them to do so at their convenience. As I will discuss later on, this was due to the fact that even in these classrooms computers were often considered a marginal teaching resource.

Teachers with a delegated style of control, a very small minority at Oakgrove and Elmway, allowed students to participate in deciding when to have access to the computers, how to handle the unexpected and some of these teachers even allowed students to decide what software to use. In classrooms with this style of control teachers also delegated the supervision of the computer corner to a select group of students. These students assisted their classmates and in one classroom they created weekly computer schedules for the whole class. As was the case in classrooms with bureaucratic styles of control, in those with delegated styles of control students took turns to carry out computer activities with minimal teacher intervention. But, once again teachers were not particularly interested in monitoring outcomes.

Variations in school and classroom structure, then, created diverse conditions for educational computing, but, to a large extent, teachers' perspectives influenced the importance, substance and the degree to which educational computing was integrated into the curriculum.

Faculty Perspectives and Educational Computing

Faculties develop customary ways of thinking about the problematic situations they face at school and act based on

them. Teachers develop group perspectives on a large number of situations, thus they typify those features of their work setting and of the students they will attend to.

Teachers' portrayed their work environments as something fixed and resistant to change. In particular, most of the teachers who did not use computers argued that it was impossible to use computers given their working conditions. These teachers described the constraints imposed by a skewed distribution of resources, by the schedule and by the lack of released time to develop computer projects. They also indicated that the prevailing definition of teachers' roles restricted their ability to develop instructional computing projects for their students. Typically teachers listed activities they were accountable for, and their responsibilities outside the school and asked when were they supposed to look for software or develop ways of instegrating it to the curriculum. Nevertheless, at each of the schools a small group of innovators was able to work around those structural conditions and implement instructional computing as a regular feature in their clasrooms.

At the start, these teachers were not more knowledgeable about computers than their peers. Knowledge was not why they became committed to computers in the first place. These teachers thought that they could enhance their teaching by

integrating instructional computing with other learning activities. One teacher, for instance, developed a LOGO unit to teach about polygons. These teachers interpreted school rules differently than their peers. Rules did not constrain them, they found ways of getting around them. For instance, it was not always possible for students to complete their assignments at the computer during regular periods. In those cases, these teachers asked students to work at the computer during their lunch break, before and after school.

Pay-offs for becoming regular computer users were not limited to the classroom. Those who became visible computer users increased their ability to have access to scarce reources. At Oakgrove, for example, they had a virtual monopoly of the hardware with more capacity. Furthermore, regular computer users were the ones who suggested what software to buy and more broadly, in what directions educational computing was going in these schools. Of the three schools, the most clear example of the influence of computer users was at Cedar Ride, where a group of computer experts had effectively limited computer use in the school to programmers and those willing to develop their own software.

The new influence gained by the computer experts was either welcomed or perceived as a threat according to how it affected each teacher's autonomy. Teachers who did not use

computers interpreted the influence of the computer buffs as a threat to their ability to define what went on in their classroom. This was particularly true at Oakgrove, where the computer teacher's attempts to assist teachers to use computers regularly were often resisted.

So while, most teachers used school established practices and rules as an explanation for why they did not engage in educational computing, others proved that it could be done under those circumstances. It is clear, however, that the cost was high in terms of commitment, and only those who perceived some pay-offs were willing to do it.

Teachers' diverse characterizations of their students was at the base of divergent ways of teaching. Although perspectives about students were grounded in the culture of each school, they did develop in different directions at the classroom level.

At Oakgrove, the socioeconomic level of the students was a salient element in teachers' characterization of their students. Teachers thought that the relative low income of the students' families created poor grounds to prepare them for academic success. (The small percentage of students who were bussed in for the magnet program did not alter the image created by the presence of a large proportion of neighborhood students.) Hence, a large number of school activities were

aimed at engaging the students in learning, making them feel that they belonged in school and challenging them to do serious work. In order to do this the staff was strict and had high expectations, but at the same time showed a lot of warmth and care for the students. According to students and teachers this behavior on the part of the staff created a feeling of being "part of a big proud family".

This characterization of students and their needs had two implications for educational computing. First, it was often assigned a marginal role in the classrooms. Teachers thought that mastering the core curriculum was more important than computing. In addition, in their view, what students could accomplish drilling at a computer came a distant second to what they could learn from the personal help given by a teacher. Second, the notion that the school was a place for "serious work" implied that teachers were the sole definers of educationally legitimate computer uses. Programming in BASIC and LOGO, drill and practice, problem solving, simulations and word processing were seen as legitimate educational uses of computers. Games were not. No adventure games or arcade-type games were used at Oakgrove, although nobody frowned upon drill and practice programs that rewarded students who had successfully solved a number of math problems with planes to shoot down.

Some teachers decided what role to assign to computers at the beginning of the year and followed it through with no variations. Such was the case of the teachers in the lower grades. In previous years, the first grade had tested relatively low in reading compared to other schools in the district. Therefore, these teachers felt that their priority was to improve students' reading skills. They committed themselves to the implementation of a new reading and writing program relegated computer activities to free time.

On the basis of their continuous monitoring of students' progress, other teachers periodically reassessed how much time to assign to computers and when students should use them. A case in point was one sixth grade teacher who had planned simulations and data bases, LOGO and word processing projects for her students. At the beginning of the school year, the one computer in her classsroom was used round the clock, but when she felt students were not keeping pace with their work she would turn it off for a few days. She even dropped the LOGO projects after a few months in order to concentrate on the math required for the students' grade level.

At Elmway, the central feature in the staff's characterization of students was their diversity. Teachers thought that given the students' socioeconomic status they had been well prepared for school. Moreover, on the basis of

previous parent intervention. teachers had come to accept that students had diverse learning needs. In fact, the desirability of having teams with divergent teaching styles was a central theme of the school's ethos. This diversity in teaching colored the implementation of educational computing. Indeed, there was more diversity at Elmway in the way teachers set up computer activities and in the kind of software they gave their students than that described at Oakgrove.

The software most often used at Elmway consisted of drill and practice, word processing, "problem solving" and games. The issue of what software could be construed as problem solving and which one was strictly games was controversial at Elmway. On the one hand, the majority of teachers, who rarely used computers, thought that unless the software dealt explicitly with school topics it should be considered a game. On the other hand, a few teachers defined any software that demanded thinking and analysis as "problem solving software". This category encompassed mathematical pieces such as "Puzzle Tanks" and adventure games such as "Mask in the Sun". Only one teacher argued that arcade-type games educational benefits such as improving eye-hand coordination. Attributing educational benefits to adventure-type and arcade-type software legitimized its use during school hours.

Aside from differing in the extent of computer use and the

kind of software selected, teaachers at Elmway differed in the degree to which they allowed students to participate in the selection of software. Teachers with a direct style of control decided by themselves what software their students would use. Teachers with a bureaucratic style of control often provided a small number of programs from which their students could choose. Teachers with a delegated style of control, negotiated with students what software to use. Some even allowed students to bring games from home.

At Cedar Ridge the implementation of educational computing was strongly shaped by how the math teachers and the computer teacher-a former math teacher herself-characterized what students had to learn and how they should learn it. To a large extent the structure of the discipline they taught shaped the sequence of skills to be learned. In addition, these teachers believed that given time to learn a skill all students could master it. Based on this perspective the math teachers had developed a curriculum in which students advanced at their own pace along a path of standardized sets of problems. Computer activities served as drill for those students who needed more practice to master a set of skills. In the lab, computers were used for programming as a means to improve students problem solving abilities, to teach them how "to figure things out". As indicated above, a central theme in this school's culture

was "to expose" all students to learning, such was the objecive of the Computer Literacy course which was taken by all seventh graders. The goal of this course was here was to get the students "hooked on computers", therefore, it focused on computer graphics, which appealed to most students. These examples illustrate how even within a school, teachers' perspectives about knowledge, about learning, and about students shape what is done with computers.

Conclusion

The previous discussion shows that the impact of various structural and symbolic elements on educational computing is not linear. It is impossible to assert, for example, that the larger the number of computers in a school the greater their use. Structural and symbolic elements affect the implementation of educational computing in more complex ways. Some, such as command over resources, operate mostly to create the conditions that enhance or inhibit computer use, while others, such as faculty culture, influence the selection of software and who has access to it. Furthermore, these elements do no operate independently from one another. For example, power and command over resources are related. Those who are more influential are also those who are often able to gain

command over some critically scarce resources. Finally, these elements do not have the same weight in all contexts. At Cedar Ridge, a skewed distribution of hardware overshadowed the possible effect that teachers' views could have had on educational computing.

The findings of this case study have implications for current efforts to implement educational computing in schools. State departments of education are giving increasing attention to computer education (Reinhold, 1986). Fran Reinhold reports in Electronic Learning's 1986 Annual Survey that: 1) computer use in schools is extending; 2) both state governments and local districts are investing more in hardware and software; 3) the National Governors' Association's Technology Task Force "makes strong recommendations for increasing funding and support for educational technology"; 4) as more states institute requirements to certify computer teachers and appoint statewide computer coordinators a supervisory structure for computer education has emerged; and, 5) the trend to use computers throughout curriculum areas and not teach computer literacy as a separate course is growing. In brief, efforts to expand computer use in the schools continue in full stride in the direction of what Herbert Kliebard (1977) has called the bureaucratic model of curriculum development. Born when school administrators applied the principles of scientific industrial

management to school management, this model, which was later applied to curricular development, values the efficient production of standardized outcomes. This case study draws our attention to some of the pitfalls of developing curriculum on this basis.

A central tenet of such style of curriculum development is the need to acquire those resources that will allow more efficient production. The Electronic Learning survey shows that most of the states are purchasing hardware and software and are investing in teacher training (Reinhold, 1986). At the same time the relevance of computer education to various areas of the curriculum goes unquestioned. This study reaffirms Sheingold et al's (1984) finding that teachers are left to consider whether the software is educational and relevant to curriculum goals. Moreover, given that hardware is still scarce and that teachers are being urged to integrate computers to all areas of the curriculum, it is to be expected that computer activities will typically consist of one or two students working at the computer. Teachers should not be asked to implement educational computing with little administrative support and blamed for not accomplishing it.

Computers can be empowering to those who learn how to use them. Seymour Pappert's (1980) accounts of what students can achieve through programming in LOGO and Sherry Turkle's (1984)

description of the role of computers in improving students' writing are among the many that illustrate this point. One must ask whether we are providing learning experiences with computers that lead to gaining command of the technology in such a way. At present the answer is that we are not. The implementation of computer activities in schools is tackled as a technical task of identifying skills to be taught and purchasing the necessary hardware and software. Taken-for-granted conceptions of knowledge, of students, and of organizational constraints go uncriticized . As a result, computer activities in the classrooms are usually limited to drill and practice.

The implementation of computer activities in these schools was pushed forward by the assumptions that computer literacy and different kinds of software applications would improve students' logical skills and achievement in various subject areas. A few teachers reflected on the relevance of computer activities for students' learning, but it was an individual not a group process; hence it did not carry on to other faculty members. A majority of teachers arrived at an abstract definition of computer activities that took into account only the time spent at the micro. Other teachers who harbored doubts about the relevance of computer activities simply became non-users.

This case study has shown how meanings about teaching and learning are contextualized. Often, educators who want to set up computing arrangements in their schools search for the solution that works. They seem to think that some solutions are better than others, irrespective of the school's structure and culture. As a result they copy solutions because they worked elsewhere. This case study alerts us to the pitfalls hidden in such an approach by showing how differences in structural arrangements and faculty culture between the three schools affected the way in which instructional activities were carried out.

Thomas Popkewitz (1978) has observed that, "as schools currently exist there is little or no time for reflection or critical analysis...Part of the problem of change becomes how to make the regular school day a period of reflective activities for teachers as well as students." (p. 440). This much needed process was absent in the schools studied, as a result, the weight of practices that had existed before the introduction of computer activities in the classrooms shaped them so that they could fit into certain time slots, address the needs of different kinds of students, and so on.

How do we teach about computers without exaggerating their importance? (Noble, 1984) How do we create situations where students work with computers without believing that

computerization is the defining characteristic of modern society? How do we expand the parameters of discussion about computers to incorporate social and political dimensions? These are some of the issues that could be reflected upon by staff and students.

The difficulty of adapting to the new technology within existing organizational and teaching arrangements was not recognized by the administration. Teachers knew that asking students to work at one computer in the classroom had the potential for disrupting established teaching styles. This case study suggests the need to pay special attention to teachers' resistance to using computers. These resistances are pointing to difficulties they have experienced in integrating computers with their present style of work and reveals an appraisal of the quality of the change they were experiencing (Shoshanna Zuboff, 1982)

Those concerned with the political and social implications of computer related activities that mystify, that draw attention away from thinking about computers to just learning how they operate (Noble, 1984), those not satisfied with parallels between computers and human brains (Mowshowitz, 1976), and those fearful of the impact of computers on social organizations (Weizenbaum, 1976) should become involved in the debate about educational uses of computers. Their concerns

have to be brought back into the debate to combat "the imperialism of instrumental reason" (Weizenbaum, 1976) in educational computing.

In brief, computers were brought to schools, among other things, to teach thinking skills and to raise achievement levels. The schools did not know whether this was being achieved because most computer activities were not evaluated. By examining how schools shaped computer activities, this study has suggested that their implementation should not be conceived as an instrumental process of identifying inputs and outputs, goals and means, but as one imbued with political and social elements. Finally, in order for meaningful, empowering computer related experiences to take place, resources have to be made available, and both the rules regulating the organization of work in schools and conceptions of curriculum have to be critically examined.

Notes

1. All the names used throughout this paper are pseudonyms.

2. The magnet program was conceived as an enrichment of the regular curriculum, not as an exclusive concentration on these areas.

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